

CHAPTER 8. Habitat issues faced by the Plum Island Sound Estuary

From a habitat perspective, the Plum Island Sound region is fortunate to be relatively undeveloped compared to other parts of eastern Massachusetts. Much of the natural habitat remains intact as protected open space (Fig. 8.1) and probably does not greatly differ in appearance from what the first European settlers saw when they arrived in the area. Nonetheless, there are still a number of threats to the future integrity of Plum Island Sound as a thriving, productive coastal ecosystem. There are also habitat issues that, while not necessarily "threats", will require some consideration in the future. These issues include:

- Decline in water quality, particularly eutrophication
- Marsh degradation caused by tidal restrictions and the invasion of aggressive, alien plant species
- Restoration of marsh areas impacted by past mosquito control practices
- Loss of anadromous fish habitat
- Fragmentation and loss of wetlands buffers and wildlife corridors
- Protecting vulnerable species of barrier beach wildlife
- Managing the potential expansion of aquaculture
- The impact on the Sound of regional changes in fish and wildlife populations
- Rising sea level

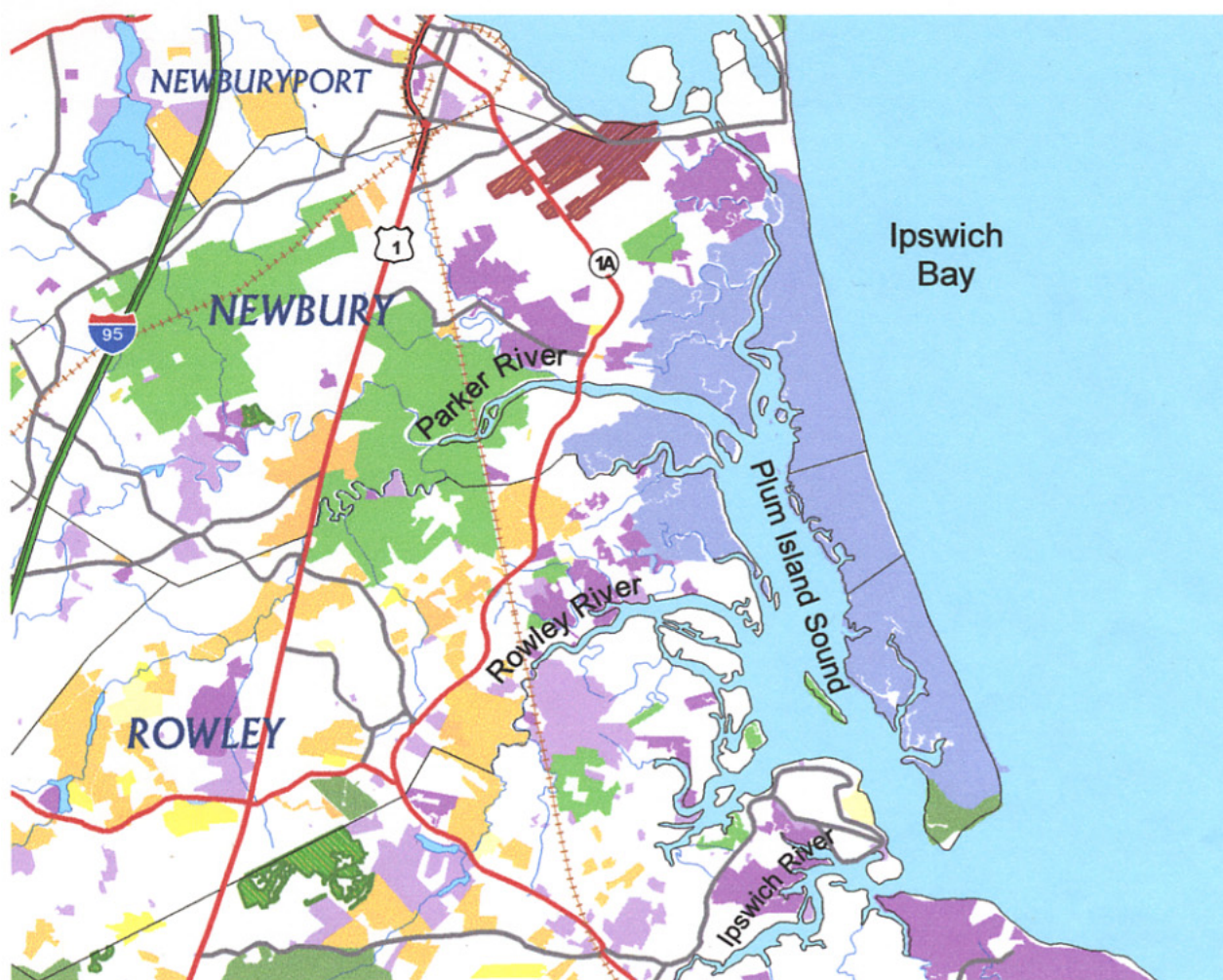
Some of these habitat issues are interrelated, yet are best discussed individually. Some are not specific to Plum Island Sound, but are reflections of regional or even global changes. In this section we describe those issues most specific to the coastal habitats, although we recognize that habitats in the surrounding watershed are also faced with a broad range of issues associated with anticipated future development.

8.1. Water Quality Decline and Eutrophication

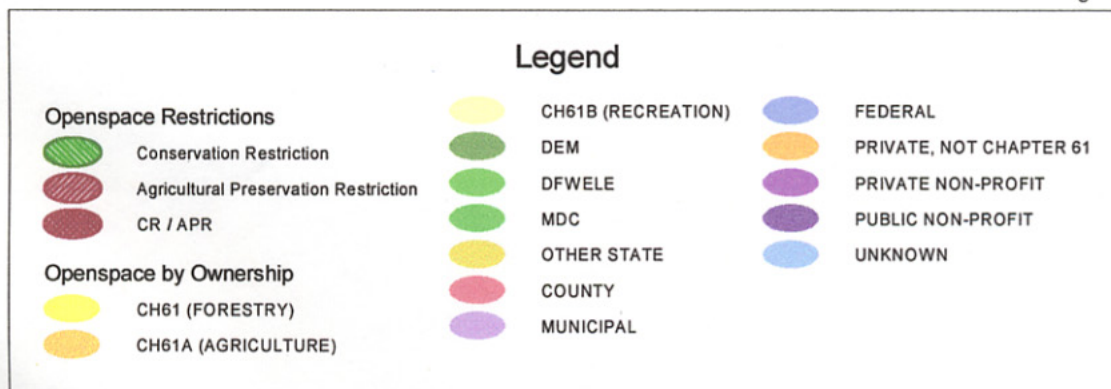
Poor water quality directly affects human uses and may also degrade habitats. Some of the tributary rivers to Plum Island Sound suffer from poor water quality, however there is no indication that the intertidal and subtidal habitats of the Sound itself have been degraded. The large amount of tidal flushing in the Sound insures adequate dilution of the present levels of pollution entering from the watershed. In the future, however, with increased development anticipated for the region, managers will need to consider the potential impacts of additional runoff into the Sound.

Of particular concern will be insuring that nitrogen loads do not increase to the point where eutrophication effects will occur. Local sources of nitrogen to Plum Island Sound include wastewater plants, septic systems, and fertilizers used for lawns and golf

Fig. 8.1. Open Space



2 0 2 4 6 8 10 12 Kilometers



courses. It is clear from our nutrient analyses that nitrogen concentrations increase in a gradient from the mouth of the Sound "upstream" to the rivers. This indicates that the uplands provide higher concentrations of nitrogen than does Ipswich Bay. In larger watersheds (e.g. Chesapeake Bay, Merrimack River), the atmosphere can also be a major source of nitrogen, but the relatively small size of Plum Island Sound makes this less likely.

Eutrophication can have a devastating effect on estuaries. Some of the impacts include:

- Lowered dissolved oxygen levels - results in emigration of mobile fish and invertebrates, alteration of benthic (bottom) communities, and, if severe, fish kills
- Increased growth of plankton - causes reduced water clarity
- Increased growth of certain seaweeds to nuisance levels- smothers important species of submerged aquatic vegetation
- Changes in the biological community to favor those species that can tolerate the above conditions - diversity and abundances typically decline (Deegan et al., 1993).

The potential for Plum Island Sound to become eutrophic due to nitrogen loading has been investigated by the Massachusetts Bays Program (Menzie Cura, 1996). Their results, based on estuarine morphology, suggest that Plum Island Sound is moderately sensitive to nitrogen, and the Parker River is highly sensitive. The large amount of tidal flushing makes Plum Island Sound less sensitive to nitrogen than other estuaries where eutrophication has been well documented, such as Waquoit Bay on Cape Cod. The Parker River is more susceptible to eutrophication than the Sound because it is closer to sources of nitrogen and less well flushed by seawater.

At the time of this writing, the Plum Island Ecosystems Long Term Ecological Research Project (PIE LTER) was carrying out monthly measurements of nutrients in the Parker River at the Central Street dam. The focus of this study is on how land use changes in the surrounding watershed might effect the estuary in the future by effecting the input of inorganic nutrients and organic matter. In addition, MCZM was carrying out further investigations of the potential for excess nitrogen loading to the Parker River.

The issue of eutrophication should not be ignored since its effects, which are so devastating, are evident in many estuaries all over the world. Preventing eutrophication should be part of any future planning for the region.

8.2. Impacts of Tidal Restrictions on Vegetation

Roads and railways have been built across the Plum Island Sound marshes since historical times to facilitate travel. The location of many of these roads corresponds to colonial era farm and trade routes. Often the roads link portions of adjacent upland separated by the salt marsh. Where the roads cross a tidal creek, culverts have been installed to allow passage of tidal waters beneath the roadway. In many cases, the culvert or bridge opening is too small

to pass sufficient tidal water to maintain salt marsh vegetation upstream and to allow passage of aquatic organisms.

The hydrologic changes caused by a restrictive crossing can significantly alter the salinity of the upstream salt marshes. By limiting the flow of seawater into a section of marsh, it creates more brackish or fresh water conditions. This freshening of salt marshes can cause a major transformation in the vegetation -- salt marsh grasses and rushes are displaced by common reed (*Phragmites australis*) or other brackish and freshwater species (e.g., cattails - *Typha angustifolia*, purple loosestrife - *Lythrum salicaria*), or in some cases upland plants.

Phragmites, a familiar tall grass with the tassel at its top, is an invasive species of much current concern. It is likely native to our region, since it evidently has been present in New England at least since colonial times. Recently, according to current thinking among botanists, an aggressive genetic stock has appeared in New England and has been rapidly invading many coastal and inland wetlands (Roman et al., 1984). Common reed often forms a monoculture of tall plants (up to two meters), leading to both lowered plant diversity and a change in vegetative structure (from a low grassy meadow to a tall reedy thicket). In Ipswich alone, 43.2 hectares of wetland are *Phragmites* dominated (WRBP, 1997).

Phragmites is already widespread in Plum Island Sound. It thrives in marshes where the natural flow of seawater is restricted by culverts or dikes such that the ratio of salt to freshwater is reduced. Initial invasions occur at the upper edges of salt marshes, areas that normally are occupied by brackish water species, such as cattails (*Typha angustifolia*) and bulrushes (*Scirpus* sp.). *Phragmites* may also move out over the salt marsh, crowding out the native salt marsh hay (*Spartina patens*). It thrives in salinities between 10 and 20 ppt (Roman et al., 1984), thus the seaward extent of its migration over the salt marsh is limited by higher salinities (typically above 25 ppt in much of the main part of Plum Island Sound). The growth of *Phragmites* may also be enhanced by higher nutrient levels, which occur where septic system leaching fields intersect groundwater near the edge of a marsh. Occasionally, *Phragmites* will grow in the middle of the marsh as well, perhaps in an area of slightly higher elevation than the surrounding marsh or where there is a source of fresh water.

The largest patch of *Phragmites* in the Plum Island Sound region covers several acres off Pine Island Road. Most patches in the area are much smaller. The large stands occur in Stage Island Pool and Hellcat Swamp on the Parker River National Wildlife Refuge are behind dikes that were built to create fresh and brackish water ponds thought to be more desirable for nesting waterfowl.

Phragmites is a concern to coastal managers because the plants are considered of less value to wildlife than native salt marsh species. It is also a concern for managers whose goals are to restore and maintain the historical marsh. *Phragmites* in the United States is not consumed to any great extent by wildlife, nor is it considered an important nesting habitat for birds that are of most concern to managers. Much of the evidence for

this is anecdotal since no one has rigorously compared *Phragmites* and native *Spartina* marshes. (In Europe, reed beds of *Phragmites* are considered very valuable to wetland wildlife and the plants are consumed by geese.) Dense *Phragmites* marshes are particularly difficult to study since access is such a problem, and it is likely that *Phragmites* does provide cover and nesting habitat for some wildlife species, such as redwing blackbirds and marsh wrens, in certain situations (Buchsbaum and Hall 1990, Buchsbaum 1994, Holt and Buchsbaum 1999). Nonetheless, based on what we know about habitat requirements, certain species of marsh birds, particularly rails, waterfowl, and sharp-tailed sparrows, have likely suffered as *Phragmites* has expanded along the east coast of the United States. These are species that thrive in *Spartina* or *Typha* marshes.

Because of management concern about the impact of road and railroad crossings across the salt marshes, the Parker River Clean Water Association (PRCWA) was funded in 1997 to inventory tidal crossings on the upper North Shore, including the Plum Island Sound region. Forty-six tidal crossings were identified within the towns of Newbury, Rowley, and Ipswich (Table 8.1, Fig. 8.2).

Table 8.1. Tidal Crossings by town in the Plum Island Sound region. Based on PRCWA, (1997).

Town	Total Tidal Crossings*	Restrictive Tidal Crossings**
Ipswich	14	3
Newbury	28	5
Rowley	4	3

*Railroad Sites are not included

**Sites were determined to be restrictive if they limited tidal flow more than five inches between the upstream and the downstream sides of the crossing.

Fig. 8.2. Tidal Restrictions



2 0 2 4 6 8 Kilometers



Legend

Tidal Restrictions

- Significant restriction
- Some restriction

- Not significantly restricting
- No information given

A direct way to control *Phragmites* is to increase tidal flushing to impacted marshes. Replacing all the culverts in which water flows under roadways and railroad beds is obviously a major undertaking, however the need to periodically repair bridges and culverts provides an opportunity to make incremental changes over time.

Management of *Phragmites* should focus on control rather than elimination. Total elimination is likely not possible and perhaps not even desirable from a wildlife management perspective. To set management priorities, it is important to evaluate the status and trends of *Phragmites* expansion in Plum Island Sound. Smaller patches of *Phragmites* that have reached an equilibrium with the salt marsh and surrounding upland are probably not detrimental to the ecosystem and are therefore not worth the effort and expense of elimination. The Massachusetts Audubon Society and the Jackson Estuarine Laboratory of the University of New Hampshire have set up long term vegetation transects in Rowley, Newbury, and Ipswich to monitor whether patches of *Phragmites* are expanding or are stable. Some of the transects are described in Buchsbaum et al. (1997).

Open Marsh Water Management (OMWM) is a mosquito control technique (see below) that has been used to control *Phragmites*. OMWM perimeter ditches at the upper edge of the salt marsh channel freshwater from the upland away from the marsh, thus insuring that salinities in salt marshes remain high enough to prevent further *Phragmites* encroachment. In a number of cases in the Plum Island Sound region, perimeter ditches form an effective barrier to *Phragmites* movement onto the salt marsh.

Purple loosestrife, *Lythrum salicaria*, is another invasive wetland plant that occurs in the Plum Island Sound region, although it is more of a problem in freshwater wetlands than in salt marshes. Like *Phragmites*, purple loosestrife is considered a pest by many wetlands managers because it has little documented value to wildlife compared to the native plant community. It is less tolerant of higher salinities than *Phragmites*, but still can invade the upper regions of salt marshes in tidally restricted areas. Research at the University of New Hampshire indicates that it cannot tolerate salinities above 8 ppt (Dzierzeski, 1993).

As with *Phragmites*, management measures that restore natural tidal flushing are the best means for controlling purple loosestrife that is invading brackish marshes. Other techniques have been used, particularly where increasing tidal inundation is either impractical or conflicts with management goals. The Parker River National Wildlife Refuge has experimented with herbicides (glyphosate), mowing, controlled burning, and drawdowns to control purple loosestrife and *Phragmites* in their Bill Forward and Stage Island Pools. They have also experimented with the introduction of a beetle that consumes purple loosestrife (and hopefully nothing else).

8.3. Salt Marsh Mosquito Control

Mosquito control practices have resulted in perhaps the most widespread impacts on the marshes surrounding Plum Island Sound. Past grid ditching is responsible for the lattice-like pattern of narrow creeks, often bordered by dredge spoils that characterize much of the "Great Marsh". Mosquito control activities are still exempted from the Massachusetts Wetlands Protection Regulations; fortunately current water management practices are more environmentally sensitive than those carried out in the past. The major activity of the Northeast Mosquito Control and Wetlands Restoration District (NEMCWRD-formerly the Essex County Mosquito Control Project) on the Plum Island marshes in recent years has been OMWM. A system of reservoirs and shallow canals are created to allow predatory fish, primarily the mummichog, *Fundulus heteroclitus*, access to pools where mosquito larvae live.

OMWM is touted as having much less ecological impact on salt marshes than past grid ditching practices. Most OMWM sites around Plum Island are less than ten acres in size, are designed to be site specific, and incorporate existing ditches and natural features as much as possible into their design. The NEMCWRD and Massachusetts Audubon have worked together to develop guidelines based on monitoring suspected mosquito breeding sites that enable managers to determine when installing an OMWM system is justified. OMWM has also been used to restore salt marshes, since standard procedures are to plug old grid ditches so that they no longer drain, to maintain and enhance salt pannes, and to channel freshwater from uplands away from the salt marsh. One such marsh where mosquito control and restoration have been combined in an OMWM system is on the Parker River Refuge near the subheadquarters.

OMWM is labor intensive and the installation work can be done only in the nongrowing season, thus only a few sites can be done each year. A more immediate solution though less permanent, is the use of the larvicide Bti (*Bacillus thuringiensis israelensis*). This bacterial-produced toxin, which is currently being used in Ipswich, is considered specific in its toxicity to mosquitoes and closely related flies and thus is considered better for the environment than broad-spectrum pesticides such as malathion and resmethrin. An important research question is the role mosquitoes themselves play in the ecology of the marsh, since they are periodically quite abundant and are eaten by fish and birds.

8.4. Restoration of Anadromous Fish Habitat

Although fish and wildlife are still generally abundant and diverse in the Plum Island Sound region, one group that has fared poorly is anadromous fish. Dams and overfishing have taken their toll, such that today's anadromous species are only a remnant of what formerly existed. Sturgeon have not been commercially harvested in the Ipswich and Parker Rivers since the mid 1800s and once abundant shad are rare. The causes of the decline in anadromous fish are discussed more fully in Chapter 4.

Although it is unlikely that fish populations can be brought back to the point they were at during precolonial times, there is great potential to enhance the fish populations

that are present. Efforts to increase blueback herring received a tremendous boost with the reconstruction of the fishway at the Sylvania Dam in the center of Ipswich in 1999. This allows the fish access to a long stretch of the river, parts of which have the potential to be spawning habitat. This project was a collaborative effort between the Division of Marine Fisheries and the Riverways Program, with volunteer labor coming from members of the Ipswich River Watershed Association and Trout Unlimited.

Alewives migrating up the Parker River and its tributaries have also benefited from recent fishway activities promoted in large measure by the Essex County Sportsmen Association and the Great Marsh Anadromous Fish Restoration Team (a collaborative of federal, state and local officials and nonprofit organizations). Six fish ladders on the Parker River facilitate the movement of alewives from Plum Island Sound to their spawning area in Pentucket and Rock ponds. Two of the fishways that were in most serious disrepair, as determined by DMF and the USFWS, were redesigned and upgraded in 2000. An Alaskan steep pass was installed on the dam near Main Street in Byfield to enable the fish to bypass a fishway that did not channel fish adequately away from the main flow of the river spilling over the dam. The reconstruction of the fish ladder at the entrance to Pentucket Pond occurred in 2000 as part of a project by the town of Georgetown to repair the Pond Street bridge and berm. The pool at the bottom of the fishway at Central Street was redesigned to better channel the fish toward the fishway.

The Essex County Sportsmen's Association has adopted the Parker River alewife run as part of DMF's Fishway Stewardship Program. The Association carries out routine maintenance, such as cleaning out brush and setting water levels.

There is potential for enhancing blueback herring populations in the Mill River. Spawning of blueback is currently limited to a small section of the river below the first dam near the old Jewell Mill at Glen Street. Constructing a fishway for this small dam would open up several more river miles of potential blueback habitat in the Mill River as well as Batchelder Brook.

Another issue that affects anadromous fish is low flows during the summer. This not only degrades the habitat but also hinders the return of juveniles to the sea. Low late summer flows on the Ipswich River have been the subject of particular attention from the media and state and national environmental organizations, but the same problem has also been noted in drier years on the Parker.

8.5. Maintenance of Coastal Wetlands, Wetlands Buffers, and Wildlife Corridors

Coastal wetlands in the Plum Island Sound region are well protected under the Massachusetts Wetlands Protection Regulations. In addition, much of the salt marsh habitat is currently under ownership or control by conservation-oriented agencies, such as the U.S. Fish and Wildlife Service, the Massachusetts Division of Fisheries and Wildlife, the Essex County Greenbelt Association, the Trustees of Reservations, and the

Massachusetts Audubon Society. Although we do not anticipate future direct losses due to human activities, there is always the possibility that the political climate that has stimulated wetlands protection efforts could change in Massachusetts, rendering other private parcels of land vulnerable to greater human impacts than are now allowed by law.

Wetlands buffers enhance wildlife habitat values by reducing the amount of disturbance to wildlife on wetlands (Desbonnet et al., 1994). In addition to the disturbance factor, a large number of semi-aquatic birds and animals depend on a combination of wetland and upland habitats, foraging in wetlands and using the surrounding upland for nesting, resting, and as a migration corridor. Maintaining an undeveloped strip of land around a wetland insures that all these life functions will be carried out. A naturally vegetated buffer also enhances scenic values.

A number of authors have suggested that a minimum buffer of 100 m is ideal for supporting a wide variety of wildlife (Brady and Buchsbaum 1989, Desbonnet et al. 1994). In many parts of eastern Massachusetts, such a buffer distance is impractical since development has already occurred within 100 m of the border of many wetlands. Because much of the Plum Island Sound region is relatively undeveloped and contains a great deal of conservation land, maintaining wide buffers is still possible in many places. Land use planning incorporating natural buffers around wetlands would go a long way toward protecting both water quality and wildlife habitat. This is an opportunity for towns to work with conservation organizations and state environmental agencies to insure that the most critical wetlands habitats (e.g. those surrounding anadromous fish spawning areas) have as wide a buffer as possible and that buffer maintenance is part of the normal planning process for any new proposed development. Even where 100 m is not possible, research indicates that some buffer is much better for wetland functions than none at all.

A related issue to wetlands buffers is maintaining wildlife corridors along rivers. Since the Ipswich River runs right through the center of Ipswich, there is no obvious possibility for a wildlife corridor there. The Parker River and its tributaries and the Rowley River still contain long stretches of undeveloped, naturally vegetated shorelines that can function as corridors for the movement of animals. Land use planning and land acquisition priorities can be targeted toward maintaining wildlife corridors along these rivers.

8.6. Protecting Vulnerable Species of Wildlife on Barrier Beaches

The major habitat protection controversy in the Plum Island Sound region in recent years has been the closure of beaches on the ocean side of the Parker River National Wildlife Refuge during the breeding season of piping plovers, roughly April through August. Since the primary mandate of the Refuge is to protect wildlife, the priority given to protecting endangered species over potentially conflicting uses is straightforward. The need to close large sections of the beach during much of the summer to protect these birds is likely to continue for a number of years.

Unlike the Parker River Refuge, the management of Crane Beach Reservation gives equal consideration to the enjoyment of area by the public and to the protection of wildlife habitat. Disturbance of resting migratory shorebirds by people, many of whom have come by boat has been an issue of concern to the Trustees of Reservations who manage the property. The Trustees have attempted to resolve this problem through public education and symbolic fencing. Trampling of beach grass and erosion of dunes has also occurred in more remote sections of Crane Beach that are not easily patrolled. Management guidelines published in *Guide to Barrier Beach Management in Massachusetts* (Massachusetts Barrier Beach Task Force, 1994) provide a framework for resolving potential conflicts.

8.7. Aquaculture

Although there are presently no plans for widespread development of aquaculture in the Plum Island Sound region, the Commonwealth's recent interest in promoting aquaculture raises the possibility that it may become an issue in the future (MCZM 1995). Plum Island Sound has extensive intertidal flats, and water quality is still relatively good compared to other estuaries on the North Shore, thus bivalve aquaculture is conceptually possible. The major habitat issue that aquaculture raises is in insuring that aquaculture is compatible with the native fish and wildlife. Potential conflicts with other user groups, such as clammers harvesting natural bivalves and recreational boaters, need to be addressed.

8.8. Regional and National Issues that Affect Plum Island Sound

The seven habitat issues discussed above are those that are amenable to some level of local control. Plum Island Sound, however, is also influenced by changes occurring on a much broader level. Overfishing throughout New England waters may have influence the types of fish found in Plum Island Sound. The changes in bird populations described earlier have also been attributed to regional factors rather than local changes. Plum Island Sound has been an accurate reflection of regional trends for fish and birds. Rising sea levels resulting from global warming will likely cause changes in as yet unanticipated ways for salt marsh and barrier beach habitats.

